

CS611

Advanced Programming Languages Radu Rugina

Administration and Overview
29 Aug 03

General Information

When	MWF 10:10 - 11:00AM
Where	Upson Hall 211
Instructor	Radu Rugina (Upson 4141)
Teaching Assistants	Siggi Cherem, Michael Clarkson, Brian Hackett
Course staff email	cs611@cs.cornell.edu
Newsgroup	cornell.class.cs611
Web page	courses.cs.cornell.edu/cs611

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Workload

- 5-6 homeworks (about half with programming requirements, in ML)
- Scribe 2-3 lectures (in pairs)
- One prelim: tentatively 10/28, 7:00-9:30 PM
- Final exam: 12/15, 12:00-2:30 PM

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Grading

- Homeworks: 40%
- Preliminary exam: 20%
- Final exam: 30%
- Class participation: 10%

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Policy for Homeworks/Exams

- NOT done in groups
 - do your own work
- Late homeworks increasingly penalized
 - Penalty linearly increasing
 - x days late = $(x * 10)\%$ penalty

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Course Contents

- What the course IS about:
formal semantics of programming languages
 - Formal frameworks for describing and reasoning about the computation in a program
 - Tools for formally analyzing and proving properties about the programs
 - Formalism \Rightarrow lots of math!
- What the course IS NOT about:
 - Survey of modern programming languages or of advanced language constructs
 - Study of implementation techniques (see cs 412)

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Advices

- CS 411 offered this fall
 - Covers the material for the CS Qual Exam
- Undergraduates advised to take CS 411 first
- Graduate students also have the CS 411 option
- **Warning:** taking CS 611 and CS 681 concurrently requires a significant amount of work

Overview

- Semantics of programming languages
 1. Semantics of a simple language
 2. Semantics of other language constructs
 3. Static and abstract semantics

Part I: Basic PL Semantics

- Three main ways to describe semantics:
 - Operational semantics
 - Denotational semantics
 - Axiomatic Semantics
- Discuss relation between different semantics
- Use IMP = simple imperative language
 - Only integers and booleans
 - Only assignments, if statements, and while statements

Part II: Language Features

- Functions
 - REC = IMP + functions, recursion
 - Lambda calculus, higher order functions
- Continuations
- Scope
- References
- Exceptions, etc.

Part III: Static/Abstract Semantics

- Types
 - Typed lambda calculus
 - Recursive types, subtyping
 - Type inference
- Abstract interpretation
 - Iterative solution
 - Widening operators
 - Formal correctness

Textbooks

- Textbooks:
 - **Glynn Winskel:** The formal semantics of programming languages
 - **Carl Gunter:** Semantics of programming languages
 - **John Mitchell:** Foundation of programming languages
 - **Benjamin Pierce:** Types and programming languages
 - **Flemming Nielson, Riis Nielson, Chris Hankin:** Principles of program analysis
- Books are on reserve in Engineering Library